

Northumbria Research Link

Citation: Hipwood, Tara (2021) Understanding low-carbon housing retrofit within a wider nexus of practices. *The Journal of Architecture*, 26 (4). pp. 453-474. ISSN 1360-2365

Published by: Taylor & Francis

URL: <https://doi.org/10.1080/13602365.2021.1925328>
<<https://doi.org/10.1080/13602365.2021.1925328>>

This version was downloaded from Northumbria Research Link:
<http://nrl.northumbria.ac.uk/id/eprint/46288/>

Northumbria University has developed Northumbria Research Link (NRL) to enable users to access the University's research output. Copyright © and moral rights for items on NRL are retained by the individual author(s) and/or other copyright owners. Single copies of full items can be reproduced, displayed or performed, and given to third parties in any format or medium for personal research or study, educational, or not-for-profit purposes without prior permission or charge, provided the authors, title and full bibliographic details are given, as well as a hyperlink and/or URL to the original metadata page. The content must not be changed in any way. Full items must not be sold commercially in any format or medium without formal permission of the copyright holder. The full policy is available online: <http://nrl.northumbria.ac.uk/policies.html>

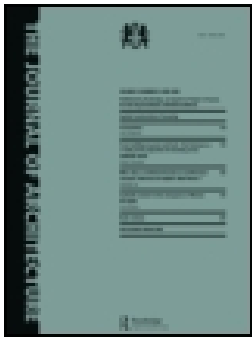
This document may differ from the final, published version of the research and has been made available online in accordance with publisher policies. To read and/or cite from the published version of the research, please visit the publisher's website (a subscription may be required.)



**Northumbria
University**
NEWCASTLE



UniversityLibrary



Understanding low-carbon housing retrofit within a wider nexus of practices

Tara Hipwood

To cite this article: Tara Hipwood (2021): Understanding low-carbon housing retrofit within a wider nexus of practices, The Journal of Architecture, DOI: [10.1080/13602365.2021.1925328](https://doi.org/10.1080/13602365.2021.1925328)

To link to this article: <https://doi.org/10.1080/13602365.2021.1925328>



© 2021 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group



Published online: 21 May 2021.



Submit your article to this journal [↗](#)



Article views: 34



View related articles [↗](#)



View Crossmark data [↗](#)

Understanding low-carbon housing retrofit within a wider nexus of practices

Low-carbon retrofit of owner-occupied housing will make a significant contribution to reducing UK CO₂ emissions. However, despite placing the home within its social context, there remain concerns that existing practice theory studies on this topic fail to adequately conceptualise 'large' phenomena such as retrofit. In response to this gap, this research adopts a novel nexus-of-practice approach to understanding home improvements. Drawing on thirty-one in-depth interviews and walk-through tours with owner-occupiers in Bristol, a rigorous line-by-line coding and analysis of the relationships between components of practice is undertaken. Particular attention is given to: connections between home improvement practices and the wider nexus of practices; how these connections can increase adoption of low-carbon retrofit measures; and the implications of these for the role of the architect. The findings reveal indirect relationships between low-carbon retrofit measures and other home improvement practices. They also illustrate that professional competences associated with low-carbon retrofit measures are poorly connected to the wider nexus. These connections have implications for policy seeking to encourage higher levels of low-carbon retrofit, and contribute to architects' ability to recognise and seize opportunities to maximise the environmental benefits of owner-occupier home improvement projects.

Tara Hipwood

*Department of Architecture and Built Environment
Northumbria University
Newcastle-upon-Tyne, UK
tara.hipwood@northumbria.ac.uk*

ORCID 0000-0001-6102-8398

Introduction

Architecture as a final aesthetic and tectonic object is increasingly being replaced by its conceptualisation as part of complex social processes that extend beyond the discipline. From the introduction of 'dependency [and contingency] as a defining feature of architectural practice' by Jeremy Till¹ to Jane Rendell's critical spatial practice, the invisible processes manifest in architecture have increasingly attracted scholarly interest. More specifically, Rendell makes a distinction between those 'representations of space that aimed to maintain and reinforce existing social and spatial orders, and those [...] spaces of representation that sought to critique and question them'.² Till argues that architecture has failed to engage with the uncertainties and contingencies of the real world, retreating

© 2021 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group
This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.



instead into an 'autonomous realm'.³ However, an understanding of, and engagement with, these contingent, invisible, and unpredictable processes can offer up opportunities to effect change and address contemporary concerns. The longer the profession avoids this engagement, the more easily it will be pushed to the margins of current debates on these issues.⁴

Perhaps the greatest of these contemporary concerns is climate change and the consequent need for more sustainable ways of building. In their critique of the way architecture engages with long-term sustainability, Ulysses Sengupta and Deljiana Iossifova argued that 'the primary limitation of current common practice in architectural education, it seems, is the inability to seriously understand architectural interventions as part of several larger and (often) dynamic systems'.⁵ They sought to address this by using 'systemic diagramming', informed by a systems-thinking approach, to identify connections with apparently unrelated issues and the role their design proposals played in maintaining or disrupting unsustainable ways of living.⁶ Meanwhile, Ezio Manzini has used an ecological understanding of systems 'characterized by the presence of the unpredictable and the unique' rather than the predictable and standardised to propose ways of designing more resilient socio-technical systems for producing power or increasing mobility.⁷

In industrialised countries such as the UK, residential buildings consume almost one third of the total energy supply.⁸ Combined with the low rate of housing replacement in many developed countries, this makes rendering the existing housing stock more energy efficient essential to reducing the CO₂ emissions from buildings that are contributing to climate change.⁹ This process is commonly referred to as 'retrofit', defined by Tina Fawcett as the adoption of home improvements that deliver carbon savings 'via energy efficiency (including in lights and appliances), use of household-level renewable energy and switching to lower carbon fuels'.¹⁰

Owner-occupied homes, which account for 69.2% of housing in the EU and 64.9% in the UK,¹¹ pose particular challenges to retrofit. For example, unlike social housing where a single organisation might be responsible for multiple houses, owner-occupiers have a high degree of independence and control over their property.¹² This in turn leads to highly bespoke home improvements that address the desires expressed by individual owner-occupiers.¹³ As such, these home improvements perfectly exemplify Till's argument regarding non-standard methods of design and the dependency of architecture on others,¹⁴ and support the need for a way of conceptualising owner-occupier, low-carbon retrofit in the wider context of social processes.

Barriers to housing retrofit such as financial concerns,¹⁵ lack of information, and a lack of appropriate legislation are well documented.¹⁶ Incentive schemes targeted specifically at vulnerable and low-income households such as the Decent Homes Programme (2000–2010) and the Warm Front Scheme (2000–2016)¹⁷ have resulted in higher uptake of energy efficiency measures.¹⁸ However, financing schemes targeting more mainstream households have either been met with limited uptake, such as the GreenDeal and the Renewable Heat Incentive,¹⁹ or have proven to be financially unsustainable in the long term, such as the Feed in Tariff and the GreenDeal Home Improvement Fund.²⁰ This has led to a growing consensus within industry and

academia that to encourage retrofit in these more affluent households, we must look beyond financial incentives.²¹

Since the introduction of social practice theory to energy consumption studies,²² scholars have begun to address these concerns, advocating that retrofit measures are understood within the context of the routine practices that take place in the home.²³ As described by Elizabeth Shove and Mika Pantzar, each of these practices is comprised of three components: skills and competences; materials; meanings and images; and the connections that hold them together through repetition of the practice.²⁴ The meanings and images described here are derived from what Theodore Schatzki has termed 'teleo-affective structures' that are both goal oriented (*telos*), and holding meaning for the practitioner (affective).²⁵ A social practice theory approach acknowledges that rather than being linear, orderly, and controllable, change is often emergent, dynamic, and arises from changes in the components that make up the practice itself.²⁶

Applications of practice theory to the subject of home improvements include that of Martin Hand and others who examined the spatial constraints that the proliferation of appliances associated with daily practices places on homes, particularly with respect to bathrooms and kitchens.²⁷ Looking more specifically at retrofit, Cecily Maller and others have also adopted a practice theory approach to demonstrate how low-carbon retrofits would be more successful if they addressed owners' aspirations and daily routines.²⁸ Despite critiques regarding whether low-carbon retrofit itself could be considered a social practice, since it does not involve regular repetition or shared understandings,²⁹ Ellis P. Judson and Cecily Maller adopted this approach to argue that the energy efficiency requirements of housing are negotiated in the context of other expectations of daily life at the household level.³⁰ Similarly, Louise Reid and Katherine Ellsworth-Krebs have used practice theory to study the adoption of micro-generation technologies.³¹ However, critics of these practice theory approaches argue that it denies the role of the individual, treating them as empty vessels waiting to fulfil predetermined practices.³² By placing too much focus on the routine they do not sufficiently explain 'large' phenomena such as: retrofit, or the ways in which variations might arise from one home improvement project to the next.³³ A nexus approach to practice theory, as advocated by Allison Hui and others,³⁴ has the potential to address some of these criticisms by focusing on the relationships within and between practices, and how they are constituted. But so far the majority of this research has focused on how material objects and their spatial or temporal proximity link practices.

The role that architects assume as 'intermediaries', defined by James Stewart and Sampsa Hyysalo as actors 'who create spaces and opportunities' for others,³⁵ in advancing energy efficient building, has been recognised by previous studies.³⁶ However, as observed by Paula Kivimaa and others,³⁷ much of the scholarship on the role of intermediaries comes from the sustainable transition literature underpinned by the multi-level perspective (MLP). This perspective describes how transitions occur when innovations work their way

through from small 'niches', into the dominant institutional 'regime', subject to external forces from the wider 'landscape'.³⁸ Agreeing that there are many different types of intermediaries,³⁹ these studies have variously positioned the architect as: a potentially important intermediary in the interpretation of the brief and associated energy efficiency regulations;⁴⁰ a neutral process intermediary undertaking day-to-day practical tasks that facilitate sustainable transitions;⁴¹ or a middle-actor, who has independent agency and capacity to create or prevent change in the system.⁴² In contrast to the MLP conceptualisation of large phenomena beyond the discretion of individuals as a landscape of 'external forces', practice theories reject the idea that there is a fundamental distinction between micro- and macro-phenomena.⁴³ Davide Nicolini states that it is through these connections between practices that large phenomena such as home improvements can be understood;⁴⁴ larger changes arise from, and are understood through, changes in the connections within and between 'localised' practices.⁴⁵ These practice theory understandings of the role that building professionals might play in facilitating such changes have received little attention to date.

Therefore, this research adopts the novel approach of conceptualising home improvements as part of a wider nexus of practice. It aims to determine if this has explanatory power to offer new insights into our understanding of owner-occupier low-carbon retrofit and the role of the architect in these home improvements. Individual research questions include:

- (1) How are home improvement practices connected to the wider nexus of practices?
- (2) How can understanding these connections facilitate an increased adoption of low-carbon retrofit measures?
- (3) What are the implications of these findings for the changing role of the architect?

The research makes the original argument that rather than being intractable as previously iterated in practice theory literature, identifying exactly how home improvement practices connect with practices in the wider context could create locally specific opportunities to make low-carbon retrofit more viable and appealing to owner-occupiers. Furthermore, at project level, architects, as a trusted source of expertise and advice, and with a detailed understanding of clients' complex needs, are uniquely placed to understand these connections. They can use them to steer home improvements towards resolutions that maximise occupants' satisfaction, whilst minimising CO₂ emissions.

Materials and methods

The research followed an inductive, qualitative research methodology that provided sufficient flexibility for the participants' perspective on the research topic to emerge and structure the investigation.⁴⁶ This approach has specific interpretivist epistemological connotations, acknowledging the distinctiveness of

humans as conscious research participants who ascribe meaning to their actions,⁴⁷ and therefore seeking to interpret participants' actions from their point of view. This moves away from the positivist preoccupation with external validity and the explanation of human behaviour, towards a greater focus on ecological validity and the understanding of human behaviour.⁴⁸ More specifically, this research aims to achieve greater understanding of the variations between retrofit and renovation projects, adopting a comparative research design. It uses the same research methods to collect data from owner-occupiers who have incorporated low-carbon retrofit measures into their home improvements, and those who have undertaken amenity-only renovations.

This research is based on data collected from in-depth interviews and walk-through tours undertaken in the homes of owner-occupiers living in Bristol. As a 'unique case', the city of Bristol offers greater explanatory power,⁴⁹ due to the more advanced stage of engagement with current policy as a Green Deal Pioneer city and an unusually prevalent concern with sustainability. This facilitated a focus on influences on home improvements rather than a discussion of the barriers that underdeveloped infrastructure can present. A geographic sampling frame comprising three wards to the north of the city (Bishopston, Henleaze, and Redland) was adopted, as geodemographics show these wards have high levels of affluence and home ownership, but the housing in this area has low levels of energy efficiency.⁵⁰ A purposive sampling strategy was adopted within these three wards, where households that had undertaken recent home improvements were identified and invited to participate by searching the Bristol City Council planning website for residential planning applications submitted between July 2012 and December 2014. Using the planning system, rather than previously studied networks such as Super-homes,⁵¹ avoided the bias towards individuals with an explicitly strong environmental agenda. However, with smaller home improvements allowable under permitted development, this had to be complemented by researcher observations in the field to identify further households that were currently or recently undertaking home improvements, which might not be subject to planning applications. In total, 325 invitations to participate were sent out between July 2015 and June 2016. Overall, 16% of respondents volunteered to take part in an interview. This sample was balanced to include different home improvements resulting in thirty-one interviews undertaken, fifteen of which included low-carbon retrofit measures (Fig. 1).

Unlike the home improvement itself, teleo-affective structures, and competences with which the improvements are associated, are not directly observable. As such, their identification is largely reliant on accounts given by participants in interviews. Research based on such interviews may suffer from post-hoc rationalisation or unconscious editing of accounts from participants. Related studies show that in response to direct questions regarding their influences, participants often underrepresent normative effects.⁵² To minimise these effects, a laddering interview technique, traditionally used in association with means-end chain theory,⁵³ was adopted. The aim was to assist owner-occupiers to 'unpack' their own home improvement project. In this laddering

Sampling Characteristic		Sample Profile (out of total 31 No. participant)	
Household Income (local average income: £700/week ⁵⁰)	Less than £700/week: 8 No. Note: these households had much lower financial burdens (dependent children, mortgage payments) than the rest of the sample.	£700-1499/week: 10 No.	More than £1500/week: 13 No.
Household	Young Families: 15 No. (defined as households undergoing or preparing for an expansion due to the birth of children).	Empty-Nesters: 16 No. (defined as households undergoing a contraction following departure of children, or preparing for retirement).	
Home Improvement	Amenity Only: 16 No. (defined as home improvements including measures that are not primarily energy-focused such as extensions and loft conversions as well as mainstream energy measures such as minimum standard gas boilers and loft insulation).	Amenity-Retrofit Combined: 15 No. (defined as home improvements including amenity measures in addition to more innovative measures associated primarily with energy and CO ₂ savings such as renewable heat or electricity, and external or internal wall insulation).	
Architect	No Architect Involvement 13 No. (6 No. Amenity only; 7 No. Amenity-Retrofit Combined)	Architect provided technical expertise to realise occupant's existing ideas. 9 No. (4 No. Amenity only; 5 No. Amenity-Retrofit Combined)	Architect was instrumental to development of the project. 9 No. (6 No. Amenity only; 3 No. Amenity-Retrofit Combined)

Figure 1.
Profile of participating households
and their home improvement
projects, © Tara Hipwood

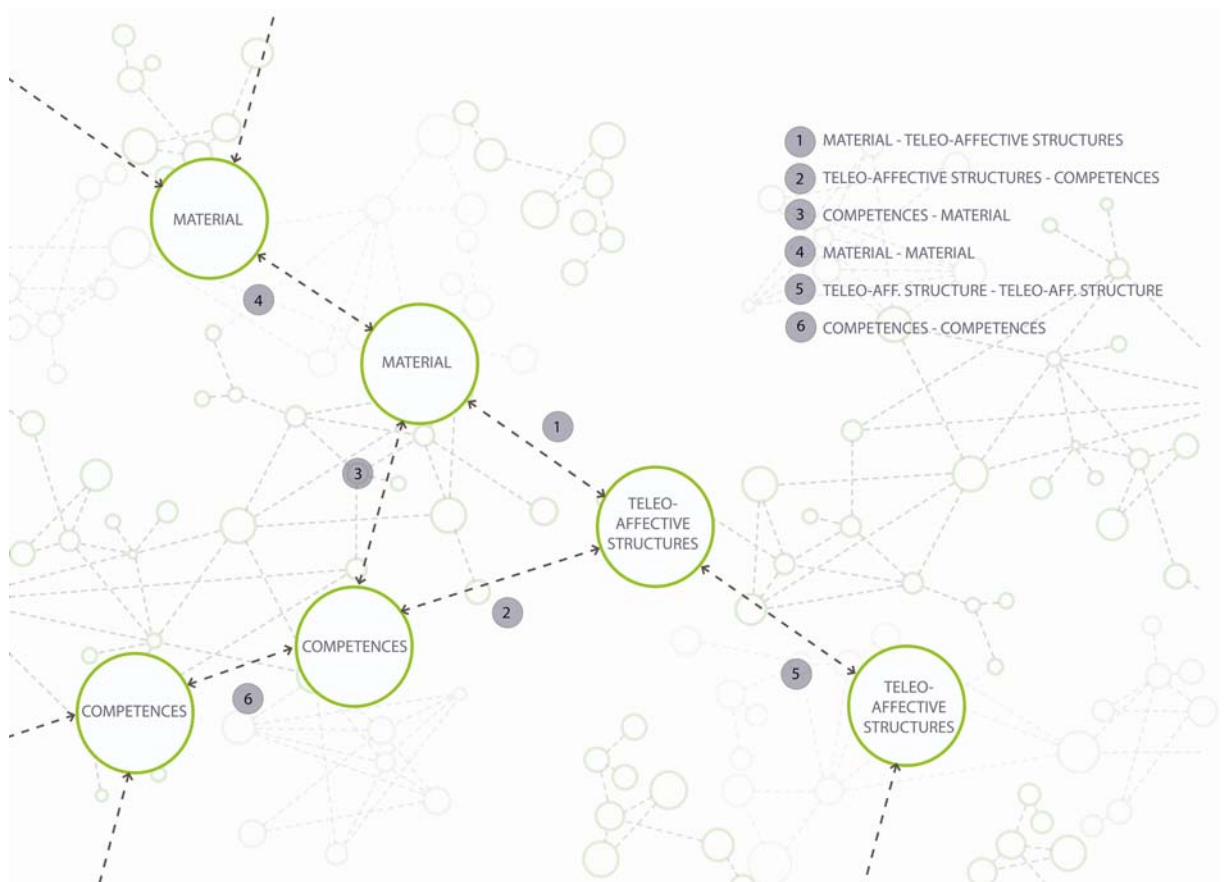
technique, each interview began by identifying a home improvement measure, such as loft conversion or solar PV panels, that had been adopted. It then worked backwards to unpack connections with the sources of advice and competences that supported adoption of these measures, the teleo-affective structures the owner-occupier associated with them, and their connection with other home improvement measures.

Interviews were complemented by, and triangulated with, data from walk-through tours that facilitated a greater awareness of the property and contextualised the participants' interview responses. Through observation of how different parts of the dwelling are used, the walk-through tour may

capture matters that the participant takes for granted and therefore may not mention in an interview.⁵⁴ Observations made during the tour were recorded using sketches, as this was deemed less intrusive than taking photographs.

Coding and analysis of the interview and observation data drew on many aspects of the constructivist grounded theory method,⁵⁵ aiming towards an inductive, interpretivist understanding of concepts emerging from the data. Each interview was transcribed in full to avoid early elimination of data on the basis of the researcher's assumptions or preconceptions, and to enable these to be coded. Initial coding used a line-by-line technique, interrogating each line of the data 'to see otherwise undetected patterns in everyday life'.⁵⁶ Emergent codes were created for home improvement measures, teleo-affective structures, and competences. The use of NVivo (v.11) qualitative data analysis software also enabled a more detailed analysis of the most frequent connections between home improvements and the wider nexus of practices, through 'relationship codes' between two of these more conceptual or substantive codes. As a result, six different configurations of relationships between practices were analysed (Fig. 2).

Figure 2.
Six configurations of relationships
connecting home improvements to
the wider nexus of practices, ©
Tara Hipwood



Results and discussion

The analysis explored these six configurations of relationships between elements as a complex nexus of practices, linked by home improvement measures and teleo-affective structures.

Teleo-affective structures as a connection between home improvements

The role that material arrangements, in this case the links *between* home improvement measures, play in linking practices together is relatively well documented.⁵⁷ Research by the Energy Saving Trust and the UK Energy Research Centre has advocated using these associations between measures to 'piggy-back' low-carbon retrofit measures onto more mainstream home improvements.⁵⁸ However, this research found that, with the exception of measures such as boilers and extensions which might evolve to also include improvements such as a new roof, the connections between the material components of home improvements were relatively few. But despite this lack of direct material connections between home improvement measures, focusing on the multiple and complex relationships between practices reveals less direct points of connection between home improvement measures. This can be demonstrated by the shared association of multiple home improvement measures with a common teleo-affective structure such as *warmth or efficiency*. This association is unsurprising; it has been well-documented by previous research.⁵⁹ However, both *warmth* and *efficiency* were also associated with a wider range of home improvement measures that included the more immediate warmth of a wood-burning stove, the visual warmth afforded by selected wall finishes, or the space-efficiency of an extension (Fig. 3).

Our architect has got one (wood-burning stove) and she commented that's a really good way [...] I work from home, so I'm here during the day, and in the winter I need to keep warm ... (Household A)

We had a single skin extension there, where the kitchen currently is. It was a bit of a waste of space. (Household B)

A greater understanding of how practices intersect in a wider nexus, allows us to consider Stanley Blue and Nicola Spurling's proposal that transitions in performances might be enacted not by changing individual practices, but by reconfiguring ways in which constellations of practices interconnect.⁶⁰ This in turn implies that policies or other interventions might induce desirable practices by shifting their focus from practices themselves to adjusting the relative strength of connections between practices. Identifying other home improvement measures associated with these concerns increases the opportunity to intervene and reinforce the associations between retrofit measures and warmth and/or efficiency, *when* and *where* these concerns are foremost in owner-occupiers' minds (e.g. at point of purchase for wood-burning stoves or conservatories). Furthermore, a shift in focus from the constitution and change of individual practices to the relationships that connect multiple practices together in a wider nexus can facilitate the identification of significant intersections in this nexus around home improvements. The teleo-affective



Figure 3.
Indirect connections through home
improvement measures through
the teleo-affective structure of
warmth, © Tara Hipwood

structures that are associated with a wider range of measures are likely to provide greatest opportunity to encourage the adoption of further home improvements. This indicates that identifying these 'busy' intersections could have significant implications for encouraging the adoption of low-carbon retrofit measures.

Measures subject to multiple teleo-affective structures

Just as the same meaning may be associated with multiple home improvement measures, the same home improvement measure may be associated with multiple meanings. In other words, the home improvement measure itself becomes the intersection in the nexus between multiple teleo-affective structures. For example, participants associated new boilers or heating systems with a wide range of meanings (Fig. 4). These included: a necessity that is immediately replaced following breakdown, as identified in previous literature;⁶¹ a matter of efficiency; or a way of accommodating the morning routine of a growing family:

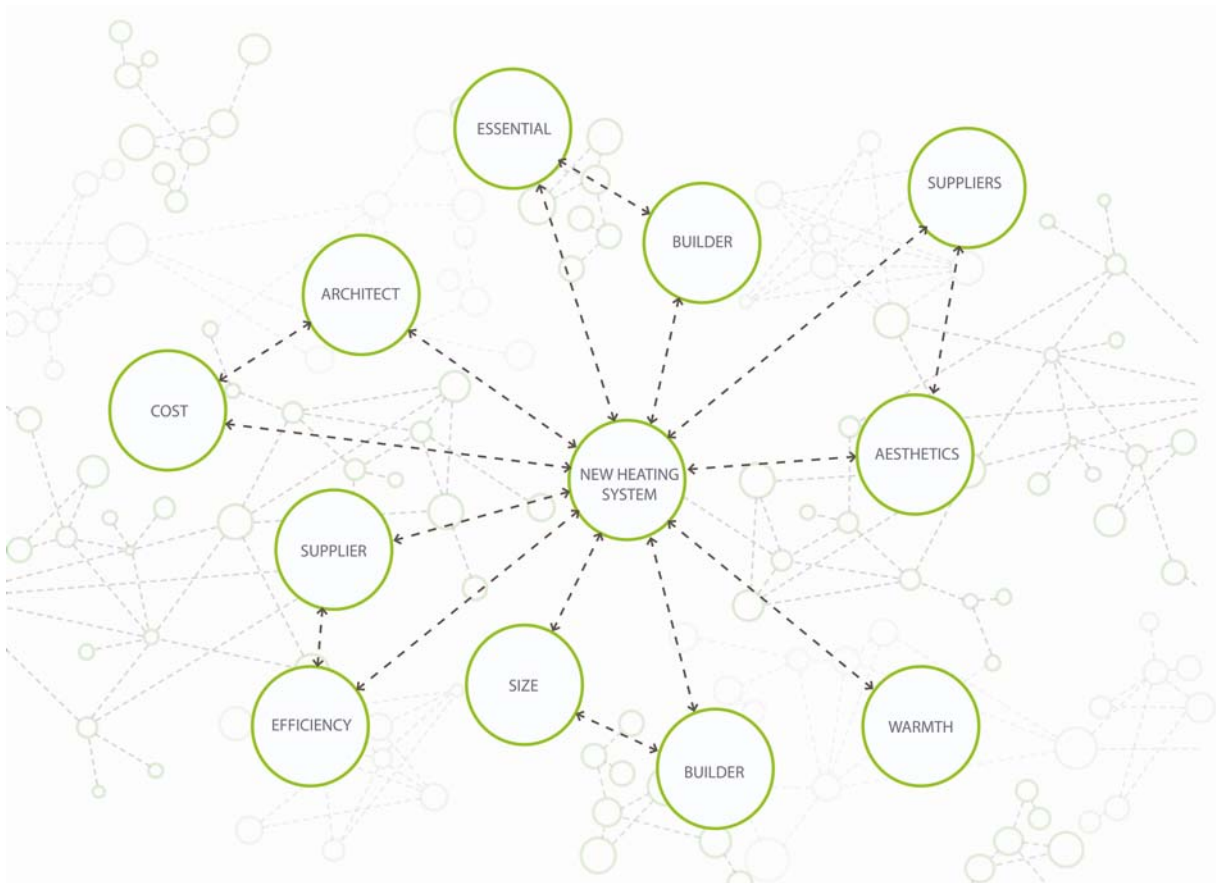


Figure 4.
A home improvement measure at
the intersection of multiple teleo-
affective structures, © Tara
Hipwood

The boiler, we didn't need a new boiler, but we had a combi-boiler, and there's a high chance that more than one person is going to be having a shower at the same time when you have quite few bathrooms, and the kids are coming up to their teens, so ... (Household A)

The approach adopted by this study, not only shifts the focus of analysis from individual practices to the connections between practices, but also from the variations in a practice over time, as discussed by Hui,⁶² to the concurrent variations in how practices of adopting home improvement measures are connected to the wider nexus of practice. This has revealed not only that home improvement measures sit at different intersections of teleo-affective structures in the wider nexus of practice, but also that the configuration of the intersections at which these home improvements sit may vary from one group of owner-occupiers to another. For example, among younger households, extensions were connected with teleo-affective structures such as *hospitality* and creating spaces for *friends and family* to gather, as reported by previous research.⁶³ Meanwhile, among older households, they were connected with *space and natural light* to undertake hobbies during retirement.

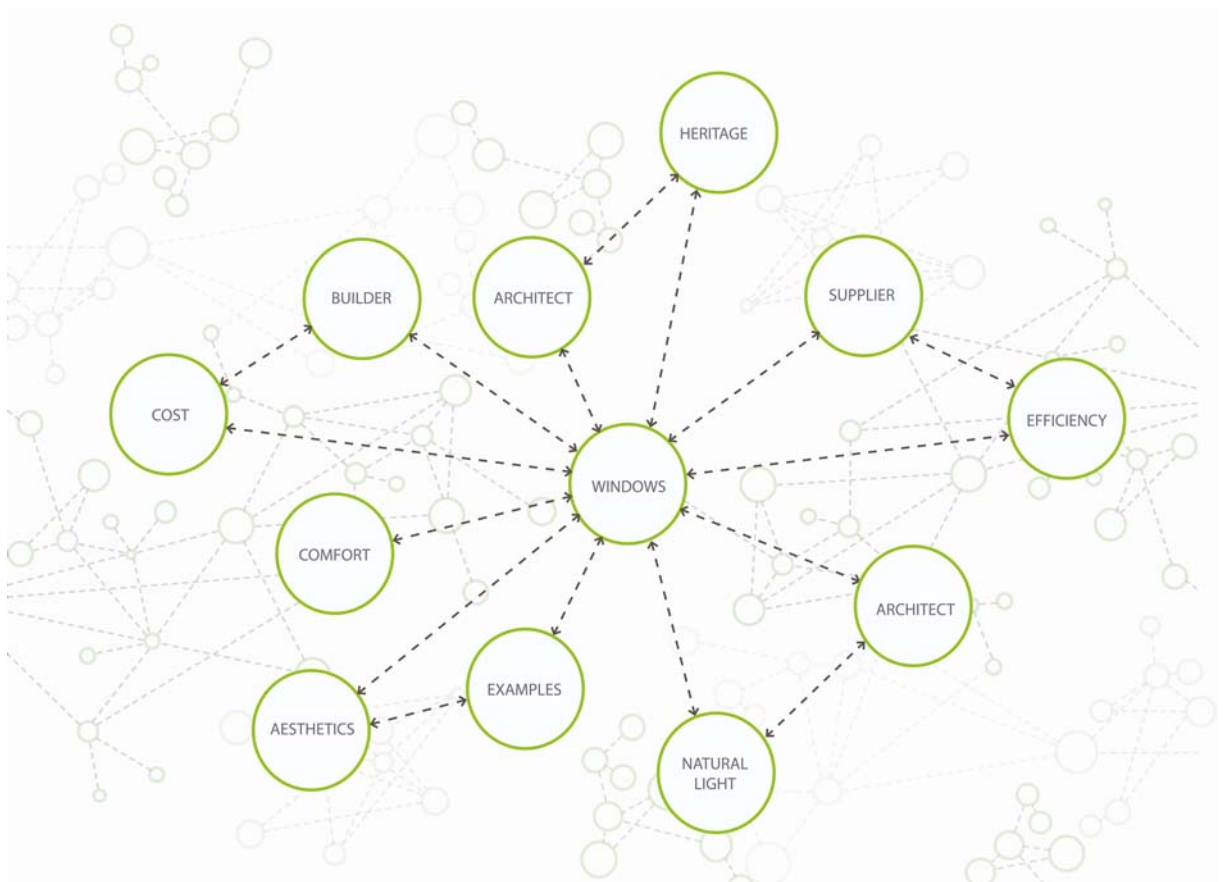
Understanding home improvement measures as the intersection between multiple teleo-affective structures that may vary from one group of owner-occupiers to another is perhaps of greatest value where such structures place conflicting demands on home improvement measures, requiring trade-offs to be made between them. As discussed by Hui, whilst multiple elements are needed for the performance of a practice, there may be different possibilities that might suffice.⁶⁴ Perhaps the best example of this are the trade-offs described by participants between the replacement, refurbishment, or secondary glazing of sash windows in Victorian terrace housing. These were associated by owner-occupiers with multiple teleo-affective structures (Fig. 5).

Well it was alright in terms of keeping the place warm but it (secondary glazing) looks a bit of a mess you know. (Household C)

... then we got the windows done at some point, which made a big difference because the windows were pretty draughty before. (Household D)

The most common connection described by participants was between new windows and significant costs. This is intriguing because, despite this association, windows are one of the most widely adopted home improvement

Figure 5.
A home improvement measure
subject to conflicting teleo-
affective structures, © Tara
Hipwood



measures. This could be seen to support previous research findings that when the intention to adopt measures is sufficiently strong, owner-occupiers will find ways to overcome the barriers of capital cost.⁶⁵ Previous research has reported that homeowners are willing to pay more in order to achieve an improved indoor environment,⁶⁶ so the association between windows and improved comfort or reduced draughts could also help to explain owner-occupiers' willingness to absorb a certain amount of cost. Meanwhile, although natural light is seldom identified as an influence on the adoption of home improvement measures, owner-occupiers considering installing secondary glazing or replacing windows discussed the importance of keeping frame sizes to a minimum to maximise the amount of natural light transmitted into the room. Furthermore, owner-occupiers discussed how aesthetic concerns were so strongly associated with the windows that the significant costs associated with replacing windows may be overcome, not due to any functional shortfalls, but purely for aesthetic reasons. More specifically, maintaining the original character of the windows had to be offset against the desire for greater efficiency.⁶⁷

Where home improvement measures are associated with multiple teleo-affective structures (such as efficiency, comfort, and aesthetics), this may be seen as increasing the opportunities to make these measures more attractive or viable to owner-occupiers in multiple ways. Alternatively, where these teleo-affective structures are in mutual conflict, it may be seen as forcing trade-offs between energy efficiency and other considerations. In a nexus approach to practices, the home itself becomes one of the material-spatial components that constitutes the intersections between practices.⁶⁸ Within and around the home, improvement measures such as new windows act as material connections between multiple teleo-affective structures, such as efficiency, comfort, and aesthetics. Understanding that home improvement measures sit at the intersection of multiple teleo-affective structures, and that the shape of these intersections will vary from one group of owner-occupiers to another, is an important first step. It allows us to better identify and understand both challenges to, and opportunities for, greater adoption of low-carbon retrofit measures. However, if we wish to increase participation in low-carbon retrofit by making the connections between this and indirectly related practices as smooth as possible, we must also pursue a greater understanding of how and why connections between owner-occupiers and material objects form in some cases, but not in others.

More immediately, these findings could support the more strategic use of financial incentives by allowing financial considerations to be understood within the context of other influences on retrofit to determine when such incentives might be most effective. As described above, in the case of older properties, elements of the dwelling such as windows are placed under conflicting demands. Owner-occupiers often find themselves in the situation of making compromises between comfort and retaining heritage, or achieving both but at higher costs. The long-term solution could be the development of products whose constraints do not create such a conflict. However, in the

short term, targeted financial incentives could help to relieve some of the conflicts between teleo-affective structures.

Competences: a gap in the nexus

In contrast to the many connections between home improvement measures and teleo-affective structures discussed above, the analysis showed that competences were far less well connected to the wider nexus of practice.

Existing literature seeking to establish which sources of knowledge or expertise are most appropriate to encourage adoption of low-carbon retrofit measures, have tended to treat retrofit as one homogenous entity.⁶⁹ In contrast, this research sought to disaggregate these findings by determining why some sources of knowledge or expertise might be accessed more commonly in association with individual home improvement measures. However, unlike the relationships between teleo-affective structures and home improvement measures discussed in the previous section, there were no sources of competence that were commonly associated by participants with a particular home improvement measure. Furthermore, the range of sources of competences with which each measure was associated was generally quite small. Instead, the research found a small number of professional competences that are accessed with regards to a wide range of measures. This included builders and architects, and in the case of retrofitters, their own personal contacts, such as friends and neighbours:

Some friends who've got a Victorian House, they'd had the internal wall insulation. Before that I didn't have any idea that it existed. (Household E)

Whether retrofitters' access to personal contacts with expertise is a cause or a consequence of the measures adopted by participants is unclear. However, it does support previous findings that retrofitters often access 'specialist' sources of advice to achieve their low-carbon retrofits that owner-occupiers might not ordinarily have access to.⁷⁰ Despite being dependent on the expertise and advice of professionals, the selected quotes represent an understanding, shared by many participants, of how to access and evaluate such advice, including obtaining multiple quotes or visiting examples of previous workmanship. However, these practices were undermined when householders did not have access to a sufficient number of suppliers or installers, as described by Household H below.

I had spreadsheets where I put all the quotes we got, compared the differences, tried to price out any elements they'd missed ... add that into their quote to compare them (Household F)

... to be honest it came down to the fact of seeing the guy's work ... and the brickwork was just immaculate. (Household G)

... we contacted both of them and only one was willing to quote. The other one just said they were too busy ... I think we probably went back to the centre for Sustainable Energy, and said 'Is there anyone else?' and they said 'not really'. And that's not very good is it? (Household H)

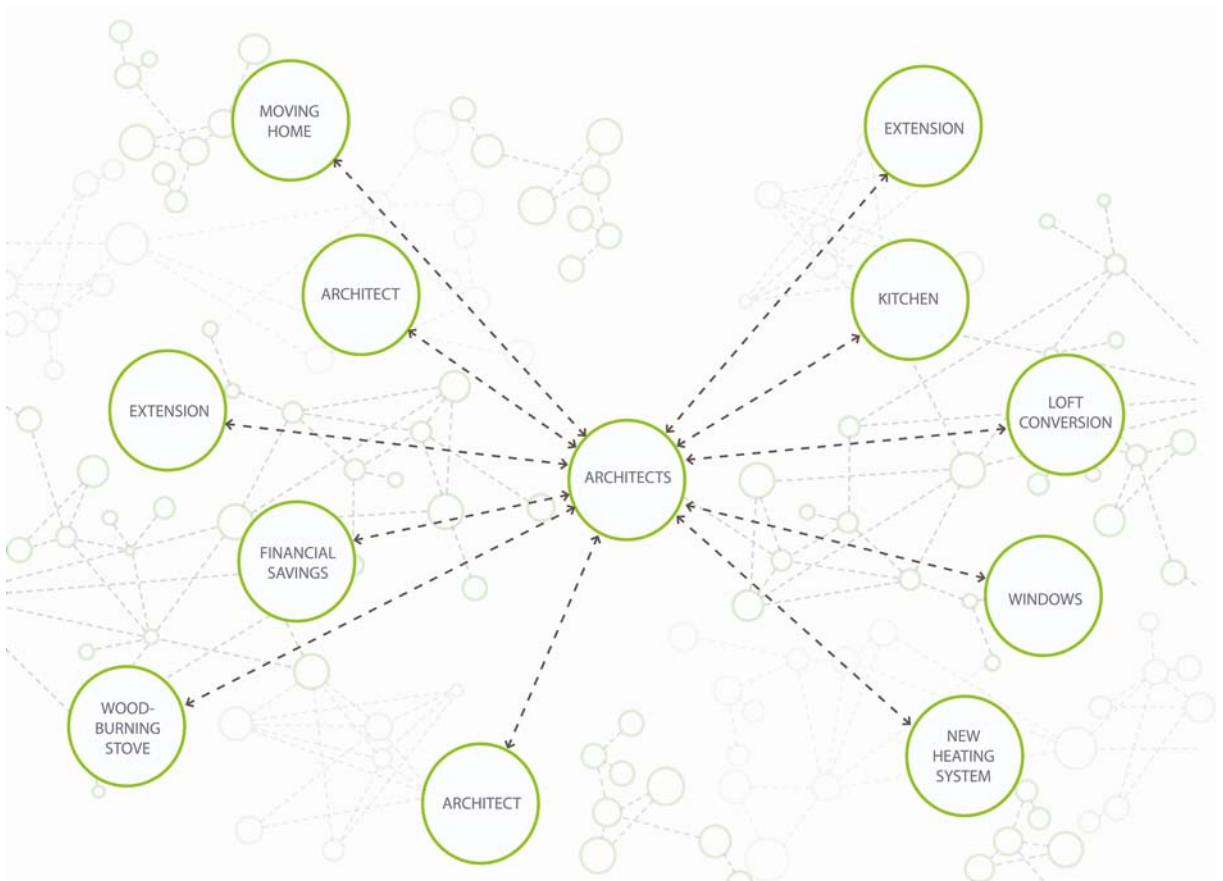
Variations in the direct connections made between low-carbon home improvement measures and the competences to support adoption of these

measures introduces an inequality between owner-occupiers in their capacity to act, as previously discussed by Matt Watson, and Håkon Fyhn and Nina Baron.⁷¹ For example, technologies such as solar photovoltaics (PV) or Air Source Heat Pumps (ASHP) require expertise beyond that of most participants. Thomas Alkemeyer and Nikolaus Buschmann have asserted that participants are not only one of the elements involved in the performance of practice and enabling transformation in practices, but through the distributed agency of practice, they themselves are also transformed and enabled to 'participate as competent "players"'.⁷² For example, the changes in competences acquired through the practice of obtaining multiple quotes, or visiting examples of previous workmanship, become the competences carried forward into further practices, allowing further connection within and between practices. This further supports the case for long-term studies of complex phenomena, in which the temporal organisation of practices across a number of individuals can be used to examine how relationships and competences develop and evolve over time, resulting in such a wide degree of variations in competence between practitioners. Furthermore, by understanding the practices that help to build these relationships and competences, it may be possible to support these practices through policy intervention.

In the meantime, the dependence of renovators on the expertise of builders and architects indicates they are a strategic point of intervention. This was also supported by the analysis of connections between competences, which, as described by Stanley Blue and Nicola Spurling, can be an organising and connective element of practice.⁷³ In this case, owner-occupiers described how architects and builders, and suppliers, were connected with a wide range of more specialised sub-consultants. This implies that the small building firms or architects' practices that undertake the majority of home improvement work mediate many of the subsequent specialists who are then brought onto a home improvement project. As such, they take up a position in the wider nexus of practices between a wide range of home improvement measures and the specialist professional competences needed to adopt them (Fig. 6). The identification of these 'bottlenecks' in the nexus, with regards to the competences to adopt low-carbon retrofit measures only serves to further highlight the important role that builders and architects can play in encouraging the adoption of these low-carbon retrofit measures.

Conclusion

This research has explored the explanatory power of a nexus approach to practices when applied to owner-occupier low-carbon retrofit. In doing so, it contributes to addressing gaps in current practice theory understandings of large and complex phenomena such as: retrofit; the variations that arise between practices; and the enablement of individual practitioners. More specifically, this involved addressing the three research questions that are discussed in conclusion below.



How are home improvement practices connected to the wider nexus of practices?

By understanding the connections between home improvement measures, whether through materials, competences, or teleo-affective structures, this research provides insight into how home improvement practices hang together, reconceptualising the home as a spatial intersection in the wider nexus of practices. This includes the material intersections that have been discussed in previous research as a potential mechanism for 'piggy-backing' low-carbon retrofit measures such as solar PV,⁷⁴ onto more mainstream home improvements such as loft conversions. However, this research builds on existing findings by also identifying the relationships with teleo-affective structures that put some home improvements at the intersection of conflicting meanings. While existing research on conflicts between practices has largely focused on how they compete for time,⁷⁵ these findings suggest that further research is needed to understand how conflicts between meanings associated with home improvement practices are resolved by owner-occupiers, even if only provisionally.

Furthermore, this nexus approach to understanding home improvements reveals the lack of commonly understood relationships between home

Figure 6.
A 'bottleneck' of competences in
the nexus of practices, © Tara
Hipwood

improvement measures and specific sources of competences. This appears to be the consequence of there being an insufficient diversity of specialist expertise in the local area for owner-occupiers to perform practices such as accessing examples of completed work, or obtaining multiple quotes through which such connections are made.

How can understanding these connections facilitate an increased adoption of low-carbon retrofit measures?

This research identifies significant variations in the teleo-affective structures and competences associated with retrofit measures by different owner-occupiers. Identifying retrofit measures, such as new boilers and heating systems, solar PV, and new windows, that appear to have well-developed associations with a range of teleo-affective structures could be applied to provide multiple ways of promoting these measures to different individuals.

Furthermore, unlike previous studies, this research makes the original argument that policy interventions that aim to increase owner-occupier competences around low-carbon retrofit, and their awareness of where to access specialist expertise, should focus on facilitating the practices through which such competences evolve. For example, this would include supporting the development of appropriate expertise amongst local SMEs, making multiple quotes and examples of previous workmanship or products easier to access, and other steps in this direction. This is particularly important among those measures that are currently not commonly related to teleological constellations or material arrangements by participants such as Air Source Heat Pumps or Solid Wall Insulation. However, in the meantime, owner-occupiers will continue to rely on well-connected professionals, such as architects, to help them access the competences that exploit opportunities for new boilers, new windows, loft insulation, and solar PV to be 'piggy-backed' onto more mainstream home improvements such as extensions and loft conversions.

What are the implications of these findings for the changing role of the architect?

The identification of architects and builders as key sources of competences regarding home improvement measures, and mediators of access to more specialised sources of advice, demonstrates the important role that architects can potentially play in encouraging owner-occupiers to adopt low-carbon retrofit measures, identified by previous work on intermediaries.⁷⁶ However, this research also identifies how these home improvements are connected to multiple and even conflicting practices. To identify and take advantage of the opportunities to incorporate low-carbon retrofit measures into home improvement measures, architects must acknowledge and engage with the wider nexus of social practices within which the home and any alterations to be made to it sit. This will allow them to identify existing connections within the nexus that can be strengthened to encourage the adoption of low-carbon retrofit measures. Recognising gaps in the nexus that challenge the adoption of these measures might also be the first step towards bridging them.

First, and most simply, architects could play an important role in reinforcing the material and spatial connections between home improvement measures. For example, by proposing to owner-occupiers that are replacing a roof that this presents an opportunity to also install low-carbon retrofit measures such as Solar PV or External Wall Insulation with minimal additional cost or disruption. Second, through their briefing and subsequent dialogue with clients, architects are able to identify the teleo-affective structures at work in home improvements that have been initiated. As such, they can play a role in reinforcing homeowners' associations between these teleo-affective structures and further home improvement measures. For example, if warmth is clearly an important factor influencing the design and specification of an extension, then the architect might also suggest the adoption of measures such as underfloor insulation or cavity wall insulation that might extend this warmth into the rest of the property. As identified by Jan Fischer and Simon Guy, the ability to act as intermediaries is dependent on the competences of the architect themselves.⁷⁷ To perform this role, architects must have: a sufficient understanding regarding the process of installing low-carbon retrofit measures to recognise when these could be integrated into an existing project with minimal additional cost or disruption; and an understanding of the potential benefits of these measures to identify those which align with the client's priorities. While in some smaller projects, a builder might undertake this role in the course of identifying the scope of the works, the architect, through their face-to-face engagement with the client during the design process, is in a unique position to recognise and pursue opportunities for the adoption of low-carbon measures. These findings support Yael Parag and Kathryn B. Janda's assertion that these 'middle actors' have agency to actively support or prevent change in the system.⁷⁸ In Till's words:

this does not mean that one purposely compromises the demands of the client, but is a recognition that there is absolutely no one right way of meeting those demands [...] and therefore, there is always the potential to wring the most phenomenal, environmental, and social advantage out of the various alternatives.⁷⁹

Last, this research has shown that many owner-occupiers rely on architects to bridge the gap between their own competences regarding low-carbon retrofit measures and the specialist expertise required for the adoption of these measures. Unless, or until, policies are put in place that address the inequalities in owner-occupier's capacities to act, architects will continue to play a key role in supporting the adoption of these measures, where owner-occupiers without pre-existing competence of these measures might otherwise be excluded. As previous research describes how competences regarding home improvements are developed through practice,⁸⁰ even where architects are not successful in securing the adoption of low-carbon retrofit measures, by reinforcing these connections they will have played a role in developing further competences regarding these measures. Owner-occupiers will take them forward into future home improvement practices.

Through a greater understanding of current social theory, and especially practice theory, architects may be better equipped to recognise the material object of a building as just one of the three mutually constitutive elements of which the practices making up social life are comprised. Recognising and engaging with the other elements of practice, namely, competences and teleo-affective structures, would enable architects to maintain their relevance in the face of pressing social and environmental concerns. Architects could avoid marginalisation by redefining their role in an expanded field of architecture; not just as designers of physical artefacts but, through these interventions, as facilitators of transformation in social practices.

Funding

This work was supported by Cardiff University, School of Geography and Planning.

Notes and references

1. Jeremy Till, *Architecture Depends* (Cambridge, MA: MIT Press, 2009), p. 151.
2. Jane Rendell, 'Working Between and Across: Some Psychic Dimensions of Architecture's Inter- and Transdisciplinarity', *Architecture and Culture*, 1.1 (2013), 128–40 (p. 130).
3. Till, *Architecture Depends*, p. 5.
4. Ibid.
5. Ulysses Sengupta and Delijana Iossifova, 'Systemic Diagraming: An Approach to Decoding Urban Ecologies', *Architectural Design*, 82.4 (2012), 46–51 (p. 46).
6. Ibid.
7. Ezio Manzini, 'How to Deal with the Future Scarcest Resource: The Environmental, Social, Economic Security. That Is, How to Design Resilient Socio-Technical Systems', *Architectural Design*, 82.4 (2012), 56–61 (p. 58).
8. Martin Achtnicht and Reinhard Madlener, 'Factors Influencing German House Owners: Preferences on Energy Retrofits', *Energy Policy*, 68 (2014), 254–63.
9. Intergovernmental Panel on Climate Change (IPCC), 'Buildings', in *Climate Change 2014: Mitigation of Climate Change.*, ed. by Ottmar Edenhofer and others (Cambridge: Cambridge University Press, 2014), pp. 671–738.
10. Tina Fawcett, 'Exploring the Time Dimension of Low Carbon Retrofit: Owner-Occupied Housing', *Building Research & Information*, 42.4 (2013), 477–88 (p. 479).
11. See Eurostat, 'Housing Statistics', 2018 <https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Living_conditions_in_Europe_-_housing_quality&oldid=400952> [accessed 22 April 2021]; Department of Energy and Climate Change (DECC), 'United Kingdom Housing Energy Fact File', 2013 <<https://www.gov.uk/government/statistics/united-kingdom-housing-energy-fact-file-2013>> [accessed 22 April 2021].
12. Robert Baumhof and others, 'Which Factors Determine the Extent of House Owners' Energy-Related Refurbishment Projects? A Motivation-Opportunity-Ability Approach', *Sustainable Cities and Society*, 36 (2018), 33–41.
13. Ralph Horne, Cecily Maller and Tony Dalton, 'Low Carbon, Water-Efficient House Retrofits: An Emergent Niche?', *Building Research & Information*, 42.4 (2014), 539–48.
14. Till, *Architecture Depends*.

15. See Pekka Tuominen and others, 'Energy Savings Potential in Buildings and Overcoming Market Barriers in Member States of the European Union', *Energy and Buildings*, 51 (2012), 48–55; Philip Brown, Will Swan and Sharon Chahal, 'Retrofitting Social Housing: Reflections by Tenants on Adopting and Living with Retrofit Technology', *Energy Efficiency*, 7 (2014), 641–53.
16. Achtnicht and Madlener, 'Factors Influencing German House Owners'; Tuominen and others, 'Energy Savings Potential in Buildings'.
17. Mark Dowson and others, 'Domestic UK Retrofit Challenge: Barriers, Incentives and Current Performance Leading into the Green Deal', *Energy Policy*, 50 (2012), 294–305; Jan Gilbertson and others, 'Home Is Where the Hearth Is: Grant Recipients' Views of England's Home Energy Efficiency Scheme (Warm Front)', *Social Science & Medicine*, 63.4 (2006), 946–56.
18. Ian G. Hamilton and others, 'Uptake of Energy Efficiency Interventions in English Dwellings', *Building Research & Information*, 42 (2014), 255–75.
19. DECC, 'Green Deal and Energy Company Obligation: Headline Statistics', November 2015 <<https://www.gov.uk/government/statistics/green-deal-and-energy-company-obligation-eco-headline-statistics-november-2015>> [accessed 22 April 2021]; Josephine Moulds, 'UK's Pioneering Low-Carbon Heating Scheme Helps Just 79 Households', *The Guardian*, 30 June 2014 <<https://www.theguardian.com/environment/2014/jun/30/uks-pioneering-low-carbon-heating-scheme-attracts-just-79-households>> [accessed 22 April 2021].
20. DECC, 'Feed-in Tariffs Scheme: Consultation on Comprehensive Review Phase 1 – Tariffs for Solar Pv', 31 October 2011 <<https://www.gov.uk/government/consultations/feed-in-tariffs-first-phase-of-a-comprehensive-review>> [accessed 22 April 2021]; Jessica Shankleman, '£24m Green Deal Fund Exhausted in a Day', *The Guardian*, 11 December 2014 <<https://www.theguardian.com/environment/2014/dec/11/24m-green-deal-fund-exhausted-in-a-day>> [accessed 22 April 2021].
21. Ray Galvin, 'Why German Homeowners are Reluctant to Retrofit', *Building Research & Information*, 42.4 (2014), 398–408; Francoise Bartiaux and others, 'A Practice–Theory Approach to Homeowners' Energy Retrofits in Four European Areas', *Building Research & Information*, 42.4 (2014), 525–38; Charlie Wilson, Lucy Crane and Georgios Chrysoschoidis, 'Why Do Homeowners Renovate Energy Efficiently? Contrasting Perspectives and Implications for Policy', *Energy Research & Social Science*, 7 (2015), 12–22.
22. Alan Warde, 'Consumption and Theories of Practice', *Journal of Consumer Culture*, 5.1 (2005), 131–53.
23. Bartiaux and others, 'A Practice–Theory Approach to Homeowners' Energy Retrofits'.
24. Elizabeth Shove and Mika Pantzar, 'Consumers, Producers and Practices: Understanding the Invention and Reinvention of Nordic Walking', *Journal of Consumer Culture*, 5.1 (2005), 43–64.
25. Theodore Schatzki, *The Site of the Social: A Philosophical Account of the Constitution of Social Life and Change* (Pennsylvania, PA: Pennsylvania State University Press, 2002).
26. Yolande Strengers, 'Peak Electricity Demand and Social Practice Theories: Reframing the Role of Change Agents in the Energy Sector', in *The Global Challenge of Encouraging Sustainable Living*, ed. by Shane Fudge and others (Cheltenham: Elgar, 2014), pp. 18–42.
27. Martin Hand, Elizabeth Shove and Dale Southerton, 'Home Extensions in the United Kingdom: Space, Time, and Practice', *Environment and Planning D: Society and Space*, 25 (2007), 668–81.
28. Cecily Maller, Ralph Horne and Tony Dalton, 'Green Renovations: Intersections of Daily Routines, Housing Aspirations and Narratives of Environmental Sustainability', *Housing, Theory and Society*, 29 (2012), 255–75.

29. See Andrew Karvonen, 'Towards Systemic Domestic Retrofit: A Social Practices Approach', *Building Research & Information*, 41.5 (2013), 563–74; Bartiaux and others, 'A Practice–Theory Approach to Homeowners' Energy Retrofits'.
30. Ellis P. Judson and Cecily Maller, 'Housing Renovations and Energy Efficiency: Insights from Homeowners' Practices', *Building Research & Information*, 42.4 (2014), 501–11.
31. Louise Reid and Katherine Ellsworth-Krebs, 'Practicing Energy Prosumption: Using Unsolicited Online Data to Reveal the Everyday Realities of Solar Thermal Panels in the United Kingdom', *Energy Research & Social Science*, 34 (2017), 191–99.
32. Thomas Alkemeyer and Nikolaus Buschmann, 'Learning in and across Practices: Enablement as Subjectification', in *The Nexus of Practices*, ed. by Allison Hui, Theodore Schatzki and Elizabeth Shove (Oxon: Routledge, 2016), pp. 8–23.
33. Allison Hui, Theodore Schatzki and Elizabeth Shove, 'Introduction', in *The Nexus of Practices*, ed. by Hui, Schatzki and Shove, pp. 1–7.
34. Ibid.
35. James Stewart and Sampsa Hyysalo, 'Intermediaries: Users and Social Learning in Technological Innovation', *International Journal Innovation Management*, 12 (2008), 295–325 (pp. 296–97).
36. See Paula Kivimaa and others, 'Towards a Typology of Intermediaries in Sustainability Transitions: A Systematic Review and a Research Agenda', *Research Policy*, 48.4 (2019), 1062–75; Mari Martiskainen and Paula Kivimaa, 'Creating Innovative Zero Carbon Homes in the United Kingdom: Intermediaries and Champions in Building Projects', *Environmental Innovation and Societal Transitions*, 26 (2018), 15–31; Ellis P. Judson and others, 'The Co-Construction of Energy Provision and Everyday Practice: Integrating Heat Pumps in Social Housing in England', *Science & Technology Studies*, 28.3 (2015), 26–53; Yael Parag and Kathryn B. Janda, 'More Than Filler: Middle Actors and Socio-Technical Change in the Energy System from the "Middle-Out"', *Energy Research & Social Science*, 3 (2014), 102–12; Jan Fischer and Simon Guy, 'Re-Interpreting Regulations: Architects as Intermediaries for Low-Carbon Buildings', *Urban Studies*, 46.12 (2009), 2577–94.
37. Kivimaa and others, 'Towards a Typology of Intermediaries'.
38. Frank W. Geels, 'The Multi-Level Perspective on Sustainability Transitions: Responses to Eight Criticisms', *Environmental Innovation and Societal Transitions*, 1.1 (2011), 24–40.
39. Parag and Janda, 'More Than Filler'.
40. Fischer and Guy, 'Re-Interpreting Regulations'.
41. Kivimaa and others, 'Towards a Typology of Intermediaries'.
42. Parag and Janda, 'More Than Filler'.
43. Theodore Schatzki, 'Where the Action Is (on Large Social Phenomena Such as Sociotechnical Regimes)', November 2011 <<http://www.sprg.ac.uk/uploads/schatzki-wp1.pdf>> [accessed 22 April 2021]; Davide Nicolini, *Practice Theory, Work, and Organization: An Introduction* (Oxford: Oxford University Press, 2012).
44. Davide Nicolini, 'Is Small the Only Beautiful? Making Sense of "Large Phenomena" from a Practice-Based Perspective', in *The Nexus of Practices*, ed. by Hui, Schatzki and Shove, pp. 98–113.
45. Theodore Schatzki, 'Keeping Track of Large Phenomena', *Geographische Zeitschrift*, 104.1 (2016), 4–24.
46. Alan Bryman, *Social Research Methods*, 3rd edn (Oxford: Oxford University Press, 2008).
47. Alfred Schutz, *Collected Papers 1: The Problem of Social Reality* (The Hague: Nijhof, 1962).
48. Bryman, *Social Research Methods*.
49. J. Clyde Mitchell, 'Case and Situation Analysis', *Sociological Review*, 31.2 (1983), 187–211.

50. Office of National Statistics, 'Neighbourhood Statistics', 2015 <<https://neighbourhood.statistics.gov.uk/dissemination/>> [accessed 17 March 2015].
51. Fawcett and Killip, 'Anatomy of Low Carbon Retrofits'.
52. Toke Haunstrup Christensen and others, 'Energy Retrofits of Danish Homes: Is the Energy Performance Certificate Useful?', *Building Research & Information*, 42.4 (2014), 489–500.
53. Jonathan Gutman, 'A Means-End Chain Model Based on Consumer Categorization Processes', *Journal of Marketing*, 46 (1982), 60–72.
54. Bryman, *Social Research Methods*.
55. Kathy Charmaz, *Constructing Grounded Theory: A Practical Guide through Qualitative Analysis* (London: Sage, 2006).
56. Ibid., p. 125.
57. Schatzki, *The Site of the Social*.
58. Energy Saving Trust (EST), 'Trigger Points: A Convenient Truth: Promoting Energy Efficiency in the Home', 2011 <<http://btckstorage.blob.core.windows.net/site621/EST%20GD%20Trigger%20Points%20report%202011%5B1%5D.pdf>> [accessed 22 April 2021]; UK Energy Research Centre (UKERC), 'Understanding Homeowner's Renovation Decisions: Findings of the VERD Project', October 2013 <https://tyndall.ac.uk/sites/default/files/verd_summary_report_oct13.pdf> [accessed 22 April 2021].
59. Fawcett and Killip, 'Anatomy of Low Carbon Retrofits'; DECC, 'Process Evaluation of the Warm Front Scheme', 28 March 2014 <https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/322901/Warm_Front_Evaluation_Report.pdf> [accessed 22 April 2021]; Marcos J. Pelenur and Heather J. Cruickshank, 'Motivations to Adopting Energy Efficiency Measures in the Home', *Proceedings of the ICE – Energy*, 167 (2014), 103–16.
60. Stanley Blue and Nicola Spurling, 'Qualities of Connective Tissue in Hospital Life: How Complexes of Practices Change over Time', in *The Nexus of Practices*, ed. by Hui, Schatzki and Shove, pp. 24–37.
61. EST, 'Trigger Points'.
62. Allison Hui, 'Variation and the Intersection of Practices', in *The Nexus of Practices*, ed. by Hui, Schatzki and Shove, pp. 52–67.
63. Ralph Horne and Tony Dalton, 'Transition to Low Carbon? An Analysis of Socio-Technical Change in Housing Renovation', *Urban Studies*, 51.16 (2014), 3445–58.
64. Hui, 'Variation and the Intersection of Practices'.
65. Fawcett and Killip, 'Anatomy of Low Carbon Retrofits'; UKERC, 'Understanding Homeowner's Renovation Decisions'.
66. Andrea Mortensen, Per Heiselberg and Mary-Ann Knudstrup, 'Economy Controls Energy Retrofits of Danish Single-Family Houses: Comfort, Indoor Environment and Architecture Increase the Budget', *Energy and Buildings*, 72 (2014), 465–75.
67. Ray Galvin and Minna Sunikka-Blank, 'The UK Homeowner-Retrofit as an Innovator in a Socio-Technical System', *Energy Policy*, 74 (2014), 655–62.
68. Blue and Spurling, 'Qualities of Connective Tissue in Hospital Life'.
69. Immanuel Stieß and Elisa Dunkelberg, 'Objectives, Barriers and Occasions for Energy Efficient Refurbishment by Private Homeowners', *Journal of Cleaner Production*, 48 (2012), 250–59.
70. Brown, Swan and Chahal, 'Retrofitting Social Housing'.
71. Matt Watson, 'Placing Power in Practice Theory', in *The Nexus of Practices*, ed. by Hui, Schatzki and Shove, pp. 141–54; Håkon Fyhn and Nina Baron, 'The Nature of Decision Making in the Practice of Dwelling: A Practice Theoretical Approach to Understanding Maintenance and Retrofitting of Homes in the Context of Climate Change', *Society & Natural Resources*, 30.5 (2017), 555–68.

72. Alkemeyer and Buschmann, 'Learning in and across Practices', p. 8.
73. Blue and Spurling, 'Qualities of Connective Tissue in Hopital Life'.
74. EST, 'Trigger Points'; UKERC, 'Understanding Homeowner's Renovation Decisions'.
75. Elizabeth Shove, Mika Pantzar and Matt Watson, *The Dynamics of Social Practice* (London: Sage, 2012).
76. Horne, Maller and Dalton, 'Low Carbon, Water-Efficient House Retrofits'; Parag and Janda, 'More Than Filler'; Fischer and Guy, 'Re-Interpreting Regulations'.
77. Fischer and Guy, 'Re-Interpreting Regulations'.
78. Parag and Janda, 'More Than Filler'.
79. Till, *Architecture Depends*, p. 183.
80. Fyhn and Baron, 'The Nature of Decision Making in the Practice of Dwelling'.